

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of

Use of Spectrum Bands Above 24 GHz For
Mobile Radio Services

GN Docket No. 14-177

Establishing a More Flexible Framework to
Facilitate Satellite Operations in the 27.5-28.35
GHz and 37.5-40 GHz Bands

IB Docket No. 15-256

Petition for Rulemaking of the Fixed Wireless
Communications Coalition to Create Service
Rules for the 42-43.5 GHz Band

RM-11664

Amendment of Parts 1, 22, 24, 27, 74, 80, 90,
95, and 101 To Establish Uniform License
Renewal, Discontinuance of Operation, and
Geographic Partitioning and Spectrum
Disaggregation Rules and Policies for Certain
Wireless Radio Services

WT Docket No. 10-112

Allocation and Designation of Spectrum for
Fixed-Satellite Services in the 37.5-38.5 GHz,
40.5-41.5 GHz and 48.2-50.2 GHz Frequency
Bands; Allocation of Spectrum to Upgrade
Fixed and Mobile Allocations in the 40.5-42.5
GHz Frequency Band; Allocation of Spectrum
in the 46.9-47.0 GHz Frequency Band for
Wireless Services; and Allocation of Spectrum
in the 37.0-38.0 GHz and 40.0-40.5 GHz for
Government Operations

IB Docket No. 97-95

COMMENTS OF QUALCOMM INCORPORATED

Dated: September 30, 2016

Dean R. Brenner
John W. Kuzin
1730 Pennsylvania Avenue, N.W.
Washington, D.C. 20006
202.263.0020

SUMMARY

Qualcomm applauds the FCC for swiftly making millimeter band spectrum in the 28 GHz, 37 GHz, and 39 GHz licensed bands and the 64-71 GHz unlicensed band available for mobile services. This action will allow the U.S. wireless industry to redouble its efforts to design and develop 5G systems and allow the U.S. to lead the world on 5G just as it leads on 4G.

Qualcomm also welcomes the agency's *Further Notice of Proposed Rulemaking* to open up more millimeter wave spectrum for licensed 5G mobile and fixed broadband services. Millimeter wave spectrum bands above 24 GHz unquestionably will support an important part of the 5G solution, but bands below 6 GHz (low-band and mid-band spectrum) will be essential for highly reliable and robust wide area 5G network coverage. Thus, while this proceeding to open up millimeter wave bands for mobile use is crucial, it is equally crucial that the agency redouble its efforts to work with NTIA, the federal agencies with spectrum needs, the U.S. Congress, and the wireless industry, to repurpose more spectrum below 6 GHz for mobile broadband.

Indeed, as the FCC aptly recognizes, 5G services will use low-band, mid-band, and high-band spectrum to deliver unparalleled forms of connectivity, not just in terms of capacity, data rates, and latency, but also in terms of many new modes of connectivity, *e.g.*, device to device, machine-to-machine, mesh, relay hubs, and, of course, traditional cellular. 5G will support new device types, like robots, unmanned vehicles, and advanced industrial machines, as well as innovative applications in areas such as manufacturing, energy, healthcare, and smart cities.

Qualcomm and its wireless industry partners are actively developing millimeter wave technologies that operate in these new mobile bands above 24 GHz. Using new advanced techniques, this high band spectrum will generate a significant return in terms of providing torrents of throughput in areas where demand is surging. We applaud the FCC's actions to adopt flexible service rules in these bands and agree that the agency should use this same approach for

the bands identified in the *FNPRM*. Qualcomm believes that the Commission should use large geographic service area licenses and define spectrum blocks that are at least 200 MHz wide, in general, to support the technologies that Qualcomm and other wireless companies are developing. Licenses should include the same terms that have spurred innovation in the mobile bands below 3 GHz, such as a 10-year term with a renewal expectancy, so long as performance requirements are met, to encourage innovation and investment in these brand new mobile bands.

The FCC should not implement the three-tiered Spectrum Access System (“SAS”) and licensing models that apply to the 3.5 GHz band in any of the millimeter wave bands at this time. Despite years of technical work on the 3.5 GHz SAS, more work is needed before mobile operations can begin in that band. Moreover, the viability of auctioning short-term, nonrenewable licenses is unproven. The Commission should rely on simple coordination mechanisms that are working successfully in other millimeter wave bands.

Also, for the bands proposed in the *FNPRM*, new spectrum sharing approaches that take advantage of the unique characteristics of millimeter wave RF propagation and related interference conditions can be used to successfully share spectrum with incumbent satellite, radionavigation, and other operations. For example, the average interference from a millimeter wave mobile handset and associated base station/small cell with a steerable antenna array is quite different from and varies instant to instant when compared to fixed operations in the millimeter wave bands or, for that matter, mobile operations in the sub-3 GHz range.

In sum, Qualcomm thanks the FCC for unleashing the initial set of millimeter wave bands for mobile use and encourages the Commission to authorize mobile operations in the second set of bands identified in the *FNPRM* so that consumers can receive the benefits of this spectrum without delay.

CONTENTS

SUMMARY	i
INTRODUCTION	1
DISCUSSION	2
I. The Federal Government Must Continue Working To Free Additional Spectrum Below 6 GHz For Mobile Use While The Wireless Industry Works To Enable Mobile Use Of The Millimeter Wave Bands	2
A. 5G Network Designs Will Be Novel, Highly-Adaptable, and Flexible.....	3
B. 5G Services In The Millimeter Bands Will Supplement Lower Band Operations To Support Very-High-Speed Broadband Where Data Demands Are High	4
C. Qualcomm Supports The FCC’s Technology Neutral Path To 5G Services Because It Has Enabled Prior Wireless Service Generations To Flourish	5
II. Qualcomm Supports The Commission’s Proposed Flexible Use Rules And Exclusive Licensing Of The Additional Millimeter Wave Bands	5
A. 24 GHz Bands (24.25-24.45 GHz and 24.75-25.25 GHz).....	6
B. 32 GHz Band (31.8-33.4 GHz)	8
C. 42 GHz Band (42.0-42.5 GHz)	8
D. 47 GHz Band (47.2-50.2 GHz)	9
E. 50 GHz Band (50.4-52.6 GHz)	11
F. 70/80 GHz Bands (71-76 and 81-86 GHz)	12
III. Performance Requirements For The Millimeter Wave Bands Must Account For The Novel Ways In Which This Spectrum Will Be Deployed	13
IV. Licensees Need The Utmost Flexibility At This Early Stage	14
A. Antenna Height Limits Could Impede Innovative Deployment Models	14
A. Implementing A “Use It or Share It” Regime In Any Exclusively Licensed Band, Including The 37.6-38.6 GHz Band, Is Poor Policy	15
CONCLUSION	16

INTRODUCTION

QUALCOMM is pleased to submit these comments in response to the Commission's *FNPRM* proposing to open more than 17 GHz of spectrum in bands above 24 GHz for 5G mobile broadband services.¹ The 5G services being designed to operate in the millimeter wave bands will enrich existing user models and applications, connect new industries and device types, and enable completely new user experiences. Qualcomm applauds the FCC's plan to implement flexible rules in these bands to accommodate a wide variety of technologies and encourage innovation in the development of next generation wireless services.

While the Commission works to open up additional millimeter wave bands for mobile broadband use, the agency also needs to continue its important work to free up more spectrum below 6 GHz for mobile broadband because this lower band spectrum will continue to be essential in the successful delivery of 4G and 5G services coast-to-coast. 5G services will use low-band (*i.e.*, sub 1 GHz), mid-band (*i.e.*, 1 to 6 GHz), and high-band (*i.e.*, above 6 GHz) spectrum to transform industries and societies to a much greater extent than previous wireless service generations. 5G networks will deliver multi-Gbps data rates and enable brand new services, applications, and devices, and empower wholly new applications by providing ultra-low latency, ultra-low power, ultra-high reliability, and ultra-high security operations.

Over the next few years as 5G services begin to be deployed, devices will be transformed into a broader range of form factors and capabilities at a much quicker pace. As a result, 5G services will introduce much broader dimensions of improvements to meet our growing connectivity needs when compared to 4G services. While 4G LTE and LTE Advanced will

¹ See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, GN Docket No. 14-177, *Report and Order and Further Notice of Proposed Rulemaking*, FCC 16-89 (rel. July 14, 2016) ("*Report & Order*" and "*FNPRM*").

continue evolving to their full potential and be deployed well into the next decade, industry and regulators alike need to move forward with enabling 5G so it can be deployed as soon as possible.

5G services will operate in multiple spectrum bands simultaneously to enhance the wireless technologies that are part of today's 4G ecosystem, such as LTE Broadcast, device to device connectivity, and LTE Unlicensed, by providing performance improvements across all topologies. 5G will support previously unseen levels of flexibility, scalability, and adaptability across a wide variation of use cases — from mission-critical applications like unmanned vehicles and remote medical procedures to Internet of Everything support of sensors and other machine-to-machine devices to ultra-reliable, multi-Gbps mobile broadband connectivity to better support the applications, services, and devices consumers increasingly are relying upon.

5G services will use a unified air interface and enable low-cost, highly energy efficient operation by accessing all spectrum bands — including the 28 GHz, 37 GHz, 39 GHz and 64-71 GHz bands the FCC authorized for wireless use in the July 2016 *Report & Order* in this proceeding and the 17+ GHz of additional millimeter wave spectrum the *FNPRM* proposes to open for licensed terrestrial services. Qualcomm encourages the Commission to open these additional millimeter wave bands in accordance with these Comments.

DISCUSSION

I. The Federal Government Must Continue Working To Free Additional Spectrum Below 6 GHz For Mobile Use While The Wireless Industry Works To Enable Mobile Use Of The Millimeter Wave Bands

The Commission's ongoing efforts to open additional spectrum bands above 24 GHz for mobile broadband need to proceed in parallel with intensified efforts with Congress, NTIA, and other federal agencies to make additional spectrum below 6 GHz available for mobile use. Much

more exclusively licensed low- and mid-band mobile broadband spectrum is needed to successfully support the expected 1000x increase in mobile broadband data demand over the coming decade.² These efforts may involve more intensive sharing among federal users in less spectrum by using wireless technologies with greater spectral efficiency. All reasonable approaches to providing additional licensed sub-6 GHz spectrum for mobile use ought to be considered.

A. 5G Network Designs Will Be Novel, Highly-Adaptable, and Flexible

5G services and applications will be supported by a new network design with much greater reliability and a high level of redundancy that leverages multiple communications access paths that use a broad collection of spectrum bands including the millimeter wave bands. 5G services will connect everything from simple sensors to complex robots, and they will need scalability and adaptability across an extreme variation of use cases. The 5G network platform will scale for a wide range of services — from traditional wide area deployments to support for enterprises, hotspots at stadiums, and residential deployments — to support a broad collection of innovative applications and device-types. In this way, 5G will enable novel service models that open up new business opportunities for providers to host new services and provide a platform for new markets and subscription models.

The fundamental building block for 5G services will be a new air interface that scales across all services and use cases, and supports all types of spectrum access rights, and operates in both unlicensed and licensed spectrum, both exclusive use and shared spectrum. All available spectrum bands will be used to ubiquitously provide new services; from the sub-6 GHz bands

² See Qualcomm website, “1000x Data Challenge,” available at <https://www.qualcomm.com/invention/technologies/1000x> (last accessed Sept. 30, 2016).

that support wide coverage to bands above 6 GHz that provide higher capacity to the millimeter wave bands that can support ultra-high, targeted capacity needs in concentrated areas with high demand.

5G services will provide broader enhancements such as scalability and reliability in addition to improving technical dimensions like data rates, capacity, and latency, as well as business dimensions like dynamic subscriptions, deployment, and network sharing models that could include new modes of third party access. 5G services will likely involve new forms of connectivity well beyond just smartphones and tablets. For all these reasons, flexible service rules, such as those the FCC adopted for the 28, 37 and 39 GHz bands, should be applied to the additional millimeter wave bands identified in the *FNPRM* because flexible service rules are essential to supporting a broad range of use cases and access models.

B. 5G Services In The Millimeter Bands Will Supplement Lower Band Operations To Support Very-High-Speed Broadband Where Data Demands Are High

5G operations in spectrum bands above 24 GHz will provide ultra-high-speed service in high-traffic areas, supplementing 5G and 4G services that use sub-6 GHz spectrum to provide coast-to-coast connectivity. The wide channels available in the millimeter wave spectrum bands will be needed to support growing traffic demands, particularly in dense urban areas and event venues, both indoors and outdoors.

5G services need to scale up as needed to provide much higher data rates and support much greater capacity to provide a very high quality user experience. The addition of proximal and contextual awareness to wireless devices will create additional value to the mobile broadband user experience. Mobile operations in bands above 24 GHz offer multiple dimensions to introducing more capacity through network densification, advanced receiver designs, and spatial multiplexing techniques that can fully leverage the wide swaths of spectrum available in

these new mobile bands. And, as noted above, to support these innovative 5G services and applications, wireless connectivity in spectrum bands above 24 GHz will have to work alongside operations in bands below 6 GHz to support highly reliable and secure, ultra-low latency, ultra-low power, and low-cost services and applications.

C. Qualcomm Supports The FCC’s Technology Neutral Path To 5G Services Because It Has Enabled Prior Wireless Service Generations To Flourish

Qualcomm applauds the FCC’s decision in the *Report & Order* and proposal in the *FNPRM* to apply to 5G services the same highly successful regulatory principles it has applied to mobile broadband services in the sub-3 GHz spectrum bands. Specifically, the Commission recognizes that flexible, technology-neutral service rules have let innovation and market competition drive rapid technology advances for each prior generation of wireless interfaces.³

Qualcomm strongly supports the FCC’s decision to use this same regulatory approach in the millimeter wave bands. Designing service rules specific to a given technology would constrain innovation because such locked-in regulations would quickly become outdated. Thus, technology neutrality must be a key aspect of the FCC’s rules given that 5G is evolving rapidly, much faster than the timescales used in administrative rulemakings.

II. Qualcomm Supports The Commission’s Proposed Flexible Use Rules And Exclusive Licensing Of The Additional Millimeter Wave Bands

Qualcomm encourages the FCC to adopt its proposal to provide flexible use exclusive licenses for the following spectrum bands that also are candidate bands for IMT-2020: 24.25-

³ See *Report & Order* at ¶ 3; *id.* at ¶ 233 (“allowing such flexibility could facilitate the efficient use of spectrum by enabling licensees to make offerings directly responsive to market demands for particular types of services, increasing competition by allowing new entrants to enter markets, and expediting provision of services that might not otherwise be provided in the near term”).

24.45 GHz and 24.75-25.25 GHz, 31.8-33.4 GHz, 42-42.5 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 71-76 GHz, and 81-86 GHz.⁴ Qualcomm strongly supports the Commission's proposed flexible framework to permit the full array of fixed and mobile service offerings in these bands without undue regulatory burdens. This flexible approach will allow the business judgments of individual FCC licensees to shape the nature of the services they provide.

Qualcomm also supports licensing these bands on an exclusive basis for flexible usage for it can support a very high quality of service and user experience. Exclusive licensing also enables quick remediation should the new operations cause interference to other users of these bands. Furthermore, exclusive use licensing assigns rights in a way that maximizes the utility of the spectrum, minimizes the potential for interference among co- and adjacent-channel users, and supports the necessary flexibility for licensees to meet the needs of end users.

A. 24 GHz Bands (24.25-24.45 GHz and 24.75-25.25 GHz)

Qualcomm supports the FCC opening these 24 GHz bands for flexible use.⁵ Qualcomm agrees with Nokia, Samsung, T-Mobile, FiberTower, Global VSAT Forum, ITIC, Mobile Future, and NCTA that mobile operations can work in these bands, and that they are attractive given their relatively low frequency of operation coupled with the potential for global harmonization which would lower the cost of equipment designed to operate in the bands.⁶

Grant flexible use rights to existing fixed licensees. In line with the Commission's action to open up the 28 GHz and 39 GHz bands, Qualcomm supports granting mobile rights to existing fixed licensees in the 24 GHz bands in order to support mobile deployments in a manner

⁴ See *FNPRM* at ¶ 373.

⁵ See *id.* at ¶ 383.

⁶ See *id.* at ¶ 382.

that simplifies coordination between fixed and mobile operations.⁷ Qualcomm also supports providing new flexible use licensees' co-primary status with existing Fixed-Satellite Service ("FSS") operators. Given that existing satellite use of this band is limited,⁸ the existing coordination procedures for satellite operations in the 25.05-25.25 GHz bands should adequately support expanded terrestrial operations.

Geographic Area Licensing. To best support the development and deployment of 5G mobile and fixed services in these bands, the Commission should rely upon larger geographic license areas, *i.e.*, Economic Areas ("EAs") in the 24 GHz bands, because they will best support the types of services expected to flourish in the bands. They will help to ensure a thriving ecosystem by incentivizing investment in new technologies we expect to be deployed here.

Licensed Spectrum Block Sizes. Qualcomm supports channelizing this band as follows: A 200 MHz block from 24.25-24.45 GHz and one 100 MHz block followed by two 200 MHz blocks from 24.75-25.25 GHz.⁹ These channel sizes recognize that 5G standards are being designed with 100 MHz channelization and will allow systems to provide substantial peak data rates to support the level of service that the millimeter wave bands are expected to support.

The millimeter wave bands, in general, have very wide channel bandwidths that can support compelling mobile service throughputs. Importantly, the dynamic variations in link quality that results from mobile operations in the millimeter wave bands, particularly in non-LOS operation, can be compensated for by using higher burst rates to drive a high quality user

⁷ See *FNPRM* at ¶¶ 383, 385.

⁸ See *id.* at ¶¶ 379, 384, 385.

⁹ See, *e.g.*, *Report & Order* at ¶ 95; Qualcomm Comments (Jan. 27, 2016) at ii, 11.

experience. This type of operation is best supported by wide contiguous blocks of spectrum that are at least 200 MHz wide.

B. 32 GHz Band (31.8-33.4 GHz)

Qualcomm supports adding primary fixed and mobile allocations in this band.¹⁰ ITU WRC-15 will study sharing in this band, and WRC-19 may approve mobile use.

At the same time, Qualcomm recognizes that mobile operations in this band may need to take action to protect deep space research in the 32 GHz band and operations in the 31.3 - 31.8 GHz passive band and appropriately share spectrum with incumbent radionavigation operations. Qualcomm believes that geographic coordination can protect these incumbent services as well as the Space Research Service (space-to-earth) operations in the Goldstone, California area.

200 MHz license size. Qualcomm supports the implementation of channels that are at least 200 MHz wide for the reasons provided above.¹¹

Geographic Area Licensing. Like the 24 GHz bands, the Commission should rely upon larger geographic license areas in the 32 GHz band because they will best support the fixed and mobile services expected to be deployed in the bands.

C. 42 GHz Band (42.0-42.5 GHz)

This band currently has fixed and mobile allocations for non-Federal use, but there are no related service rules. Qualcomm supports the FCC defining service rules to enable fixed and mobile operations in this band, which, like the 32 GHz band above, is being studied

¹⁰ See *FNPRM* at ¶ 389.

¹¹ See *id.* at ¶ 399 (proposing to license in 200 MHz or 400 MHz wide channels).

internationally for mobile use, while recognizing the need to protect Radio Astronomy (“RA”) operations in the adjoining 42.5-43.5 GHz band.¹²

License areas, license sizes. Qualcomm supports geographic licensing of this band, and we propose licensing the band as follows: two 200 MHz blocks at the lower end of the band and one 100 MHz block at the upper end of the band.¹³

Sharing regime. The FCC should rely upon simple coordination methods to enable sharing on time/place basis in this band. Qualcomm agrees with the Commission that “it is possible for both Federal and non-Federal users to coexist on a co-primary basis, particularly using simple methods of coordination.”¹⁴ It should not implement in this band an SAS sharing regime that is modeled on the 3.5 GHz approach where simpler means of coordination are viable.

D. 47 GHz Band (47.2-50.2 GHz)

Qualcomm supports the promulgation of service rules to enable fixed and mobile operations in this band. Like the 42 GHz band, this band also has fixed and mobile allocations for non-Federal use, but there are no service rules for such terrestrial operations.¹⁵ This band also is allocated for FSS use, and while there are service rules in Part 25 of the Commission’s rules, there are no currently authorized FSS operations.

Sharing regime. Of the three sharing options the FCC identifies for sharing between FSS UEs and terrestrial operations, the third approach that assigns priority to terrestrial (*i.e.*, mobile and fixed) operations and to FSS operations on a first come, first serve basis looks to be the most flexible and efficient approach. The Commission’s second proposal, which divides the

¹² See *FNPRM* at ¶¶ 400, 403.

¹³ See *id.* at ¶¶ 403, 406.

¹⁴ See *id.* at ¶¶ 407.

¹⁵ See *id.* at ¶¶ 408, 410.

band in two pieces where terrestrial and FSS are assigned priority in a predetermined manner could lead to inefficiencies where spectrum resources lie fallow.

In this band, as well as other millimeter wave bands, the Commission can look to spectrum sharing approaches that take advantage of the unique characteristics of millimeter wave RF propagation and novel interference conditions these bands experience to enable successful spectrum sharing with satellite operations. For example, the average interference from a millimeter wave mobile handset and associated base station/small cell with a steerable antenna array is quite different from and varies instant to instant when compared to fixed operations in the millimeter wave bands or, for that matter, mobile operations in the sub-3 GHz range.

It is easier to enable simultaneous operation in close proximity by separating diverse operations in the spatial domain. Highly directional millimeter wave antenna systems on base stations/small cells mitigate interference to potential victim receivers because their narrow fixed beams continually move from device to device so any on-axis interference a victim experiences is a limited statistical event. The interference is further mitigated as the antenna beamwidth is reduced, which results in substantially lower antenna gain (*i.e.*, much less power) towards off-axis interference victims. It also is important to recognize that mobile devices operating in the millimeter wave bands may often use lower transmit power and narrow beamwidths that greatly reduce the interference impact and number of potential interference victims.

License size. The FCC asks for comment on allocating the band in six 500 MHz blocks, while noting that the other mmWave licensed bands have 200 MHz blocks.¹⁶ Qualcomm recommends that the Commission divide the band into six 400 MHz blocks and three 200 MHz blocks.

¹⁶ See *FNPRM* at ¶ 417.

E. 50 GHz Band (50.4-52.6 GHz)

Qualcomm supports the FCC proposal to authorize fixed and mobile services in this band using geographic licensing on a PEA basis.¹⁷ We recognize that the adjacent 50.2-50.4 and 52.6-54.25 GHz bands are passive bands, and that the lower adjacent band is used for weather prediction and disaster management. Qualcomm will review and respond to the limits on emissions into the 50.2-50.4 GHz band that the incumbent services ask the FCC to impose. We recognize that current FCC rules limit emissions into the 52.6-54.25 GHz band to no greater than -33 dBW/100 MHz.¹⁸

License size. Given that this band is 2.2 GHz wide, Qualcomm recommends that the Commission divide the band into four 400 MHz blocks and two 200 MHz blocks.

Sharing with other operations. The FCC also recently sought comment on a Petition for Rulemaking to allocate and authorize additional uplink (earth-to-space) spectrum for FSS use in this band, *i.e.*, from 50.4-51.4 GHz and 51.4-52.4 GHz.¹⁹ As this spectrum band is under active consideration for 5G services in this proceeding, the Commission should not take separate action to authorize additional FSS uplink use without assessing its impact on the use of the band for terrestrial services. Boeing should demonstrate how use of the band for satellite uplink service could protect terrestrial 5G services from harmful interference. Qualcomm believes that it may be possible to employ spectrum sharing techniques, such as those discussed above in Section II.D, to avoid interference from FSS earth station transmissions.

¹⁷ See *FNPRM* at ¶ 420.

¹⁸ See *id.* at ¶ 418.

¹⁹ See RM-11773, Boeing Company Petition for Rulemaking, Allocation and Authorization of Additional Spectrum for the Fixed-Satellite Service in the 50.4-51.4 GHz and 51.4-52.4 GHz Bands (June 22, 2016).

F. 70/80 GHz Bands (71-76 and 81-86 GHz)

While mobile equipment designs for these very high bands are at an earlier stage of development than the lower millimeter wave bands, the attractiveness of the 70/80 GHz bands is increasing particularly because they experience less attenuation than frequencies in the 50 to 60 GHz range.²⁰ They offer very wide bandwidth, enabling multi-Gbps capacities over a distance of several kilometers. Thus, the FCC and industry should continue to study how these bands can best support fixed and mobile uses.

Spectrum coordination. The existing regulatory framework is working very well, as the FCC itself notes,²¹ as there are no reports of interference for over 22,600 registered point-to-point links. The Commission should look to extend this current framework in order to allow mobile operations in this band, rather than force fit an unnecessarily complex SAS approach into this setting.²² Also, given that the bulk of the registered links are located in just 16 counties, there is space for potential mobile operations.²³

Indoor unlicensed use in this band requires more study. Additional study is needed before unlicensed use in the 70/80 GHz band, even indoors, can be authorized. Specifically, the risk of interference to outdoor backhaul operations from indoor use needs study. The availability of 14 GHz of unlicensed spectrum in the 60 GHz band should be sufficient for indoor operations at the present time.

²⁰ See *FNPRM* at ¶ 433.

²¹ See *id.* at ¶¶ 438-39.

²² See *id.* at ¶¶ 440-41.

²³ See *id.* at ¶¶ 432. The present third-party database approach that is coordinated with NTIA works fine to protect federal users as all federal sites here are fixed.

III. Performance Requirements For The Millimeter Wave Bands Must Account For The Novel Ways In Which This Spectrum Will Be Deployed

The unique characteristics of the millimeter wave band deployments, including where they are used to support both mobile and fixed operations, necessitates new thinking with regard to performance requirements, as the Commission rightly recognizes.²⁴ Performance metrics for the millimeter wave bands must be as flexible as the underlying service rules to account for the broad range of 5G services, usage models, and applications. Some deployments may comprise large numbers of devices densely packed into small areas, while others may offer service using a relatively small number of high-capacity devices deployed over a large area. Accordingly, the FCC should evaluate performance showings on a case-by-case basis at this early stage to afford licensees the necessary flexibility to develop and deploy innovative new services and demonstrate novel service showings.

Given that millimeter wave deployments will differ from traditional cellular deployments in significant ways, FCC performance requirements have to reflect those differences. For example, base stations supporting bands above 24 GHz will likely have very small coverage areas and limited geographic coverage even in the aggregate. Many of these millimeter wave base stations will be integrated into networks that use low- and mid-band spectrum to provide wide area coverage and network coordination.

While millimeter wave macrocells can use beam steering to generate narrow, highly-focused beams in highly dense environments, Qualcomm expects most mobile deployments in these bands to be densified collections of small cells. In this case, relaying between small cells and mesh-like architectures will support both data and control plane communications. Device-

²⁴ See *FNPRM* at ¶ 465.

to-device connectivity will expand coverage and support sharing of cached content among nearby users. Thus, Qualcomm expects these spectrum bands will be utilized to provide wireless connectivity without any fixed infrastructure.

Accordingly, an entirely new metric not tied to human population coverage should be developed for these millimeter wave deployments to more accurately assess the level of spectrum utilization. Recognizing that the core goal of a performance requirement is to ensure that wireless services are being provided and that the spectrum does not lie fallow while allowing for deployment flexibility, it will be more appropriate to base a performance requirement for the millimeter wave bands upon the number of connected devices, the volume of transmitted data, and/or the number of communications sessions rather than on population coverage or a level of infrastructure deployment. In sum, Qualcomm believes that the performance metrics for these millimeter wave bands must be as flexible as the underlying service rules to account for the broad range of 5G services, usage models, and applications.

IV. Licensees Need The Utmost Flexibility At This Early Stage

A. Antenna Height Limits Could Impede Innovative Deployment Models

The FCC should not impose antenna restrictions on millimeter wave base stations.²⁵ 5G mobile network equipment will be deployed at lamppost heights and at street level, but service providers also may operate point-to-point facilities in these bands that require line of sight operations hundreds of meters above ground level. Recognizing the likelihood that both architectures will emerge, an appropriate power level at a licensee's border would best protect operations in adjacent service areas.

²⁵ See *FNPRM* at ¶ 506.

Thus, antenna height limits or beam tilt requirements should not be imposed, but instead be tools available to operators to meet necessary power levels at a border to protect adjacent operators. Indeed, the Commission should allow diverse service licensees to work together to coordinate height of facilities, beam tilt, and angular discrimination as needed to protect each other in the same market, and to meet the power levels at a border to protect adjacent service areas.

A. Implementing A “Use It or Share It” Regime In Any Exclusively Licensed Band, Including The 37.6-38.6 GHz Band, Is Poor Policy

Aside from the 37.0-37.6 GHz portion of the 37 GHz band, where the Commission has imposed a license-by-rule sharing framework, the FCC should not mandate sharing in any of the millimeter wave bands that are exclusively licensed for flexible use, including the 37.6-38.6 GHz band. The Commission has designated the 37-37.6 GHz band for shared, license-by-rule use, under site licensing, and this band can serve the same use cases as a “use it or share it” approach at 37.6-38.6 GHz.

Given the nascent stage of mobile deployment in all the millimeter wave bands, the FCC should not adopt “use it or share it” obligation because it is currently unknown how licensees will use their new flexible use rights.²⁶ Such an obligation would introduce uncertainty at an early and critical stage and could deter investments necessary to make millimeter wave mobile deployments successful. Moreover, as a result of the July 2016 *Report & Order* in this proceeding, there is now 14 GHz of unlicensed spectrum that runs from 57-71 GHz, a shared band that can be used by any terrestrial user that complies with the Commission’s general technical rules.


²⁶ See *FNPRM* at ¶¶ 460-64.

CONCLUSION

The FCC should make additional spectrum resources in the millimeter wave bands available for mobile broadband in accordance with the foregoing Comments. As Qualcomm and others have explained in this proceeding, the millimeter wave bands will support an important piece of the 5G solution along with sub-6 GHz spectrum bands. Thus, it is equally as important that the FCC, NTIA, federal agencies that use spectrum, and Congress redouble their efforts to free additional sub-6 GHz spectrum for commercial mobile broadband use because these low- and mid-band spectrum resources will be essential to successful, highly robust, and ubiquitous 5G mobile broadband deployments.

Respectfully submitted,

QUALCOMM INCORPORATED

By: 

Dean R. Brenner
Senior Vice President, Government Affairs

John W. Kuzin
Senior Director & Regulatory Counsel

1730 Pennsylvania Avenue, N.W.
Suite 850
Washington, D.C. 20006
202.263.0020

Attorneys for QUALCOMM Incorporated

Dated: September 30, 2016